A METHODOLOGY FOR ECONOMIC ANALYSIS OF PROPOSED AUTOMATION PROJECTS OF THE SHORE SUBSYSTEM OF THE NAVAL TELECOMMUNICATIONS SYSTEM

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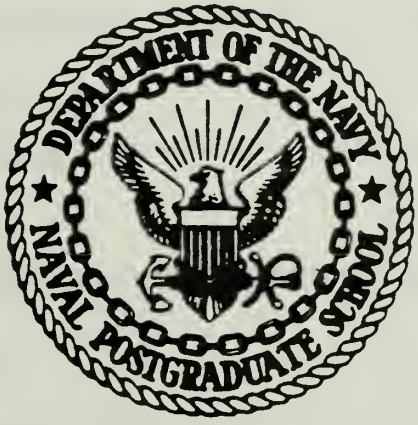

THESIS

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by

Joanne M. Mosig

March, 1981

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This thesis presents a historical perspective on progress toward the objective of automating the Naval Telecommunications System (NTS) in the most economical manner possible. In addition, a methodology for conducting economic analysis of proposed automation projects will be developed. This methodology is based on concepts such as the analysis of geographical areas and telecommunications needs therein, as opposed to the current practice of site-by-site analysis. The basic premise of the methodology is that

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Comparisons should be based upon incremental present value life cycle cost and incremental improvement in effectiveness measures for multiple alternatives. An actual application of the methodology will be presented, using data compiled for the automation feasibility studies in the Norfolk and New Orleans areas. Finally, conclusions and recommendations will be presented based upon these evaluations.

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A Methodology for Economic Analysis of Proposed Automation Projects of the Shore Subsystem of the Naval Telecommunications System

by

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LIST OF ABBREVIATIONS

ACP	Allied Communications Publication
ADP	Automatic Data Processing
ASC	Automatic Switching Center
AUTODIN	Automatic Digital Network
CNO	Chief of Naval Operations
COMNAVCOM	Commander, Naval Communications Command
COMNAVTELCOM	Commander, Naval Telecommunications Command (formerly COMNAVCOM)
DEPSECDEF	Deputy Secretary of Defense
DoD	Department of Defense
ECC	Electronic Courier Circuit
IS/A AMPE	Inter Service/Agency Automated Message Processing Exchange
LDMX	Local Digital Message Exchange
MPS	Message Processing System
MTCC	Marine Telecommunications Center
NAVCAMS	Naval Communications Area Master Station
NAVCOMMUNIT	Naval Communications Unit
NAVCOMPARS	Naval Communications Processing and Routing System
NAVCOMSTA	Naval Communications Station
NAVTELSYSIC	Naval Telecommunications System Integration Center
NCAP SPP	Naval Communications Automation Program Subsystem Project Plan
NCS	National Communications System

NTCC	Naval Telecommunications Center
NTS	Naval Telecommunications System
OTC	Over-the-Counter
PVLCC	Present Value Life Cycle Cost
RIXT	Remote Information Exchange Terminal
SAT	Standard AUTODIN Terminal
SEC DEF	Secretary of Defense
SRT	Standard Remote Terminal
TCC	Telecommunications Center
WWMCCS	Worldwide Military Command and Control System

I. INTRODUCTION

The current impetus for the Naval Telecommunications System is the implementation of automation in the most economical manner possible. Reaching this goal has been an evolutionary process that began in the mid-sixties with the realization that then-current communications systems were not meeting the critical command and control needs of the service. The initial response to this need was maximum automation at any cost. More recently, however, the approach has been modified to reflect the changing times and the decrease in the criticality of the need.

Although concepts have changed, actions corresponding to the concepts have been slow to respond. Economic analyses of proposed automation do not currently examine, in a quantifiable way, all of the benefits to be derived from automation, nor do they address whether proposed alternatives are cost-effective. The analyses are still based upon imperfect or incomplete considerations of cost. This can be seen in the way alternatives are presented: usually, the options offered are full automation or none at all.

In the following chapter, the question of automation will be put in historical perspective, and the evolution of the current system will be described. Chapter III presents more detail about the developments of the past five years, and describes the Naval Telecommunications Automation Program Subsystem Project Plan (NTAP SPP). In Chapter IV, an analytical methodology will be developed, and, in Chapter V, this methodology will be applied to two proposed automation projects. The final chapter will summarize conclusions and present recommendations.

II. HISTORY OF THE DEVELOPMENT OF THE AUTOMATION PROGRAM

A. BACKGROUND

In the autumn of 1966, in the course of a fleet exercise entitled BASELINE II, it became apparent that there were a number of inadequacies in the Navy's communications system, specifically with respect to its ability to meet the critical requirements of expeditious handling of command and control message traffic. High-precedence messages of a time-sensitive nature, which had a direct bearing on the success or failure of operations, were unacceptably delayed. "For example, 50 percent of all FLASH precedence messages to a ship required 57 minutes or longer in transit, and 50 percent of all IMMEDIATE precedence messages required 2½ hours or longer in transit." [4:1]

The minimum acceptable standard in such situations is stated in an Allied Communication Publication, ACP 121. It is ten minutes for FLASH messages, and 30 minutes for IMMEDIATE messages. Upon investigation, the delays encountered during the fleet exercise were determined to have been caused by processing delays in transmitting and receiving communications centers, and these processing delays, in turn, were attributed to the numerous manual operations required in processing the messages. These manual operations were slow and error-prone, and they also tended to compound themselves during periods of crisis, when volume increased drastically over a short period of time. In response to these deficiencies related to manual operations, the Chief of Naval Operations (CNO) directed, in November of 1967, that a single program be developed to encompass all

activities associated with the automation of naval communications. This program was to be directed by the Commander, Naval Communications Command (COMNAVCOM). The CNO further directed that "message processing automation be based on a system concept, applicable to both afloat and ashore communications, consisting of two primary modularized system components, the LDMX (Local Digital Message Exchange) and the NAVCOMPARS (Naval Communications Processing and Routing System)." [4:3-4]

In compliance with this directive of the CNO, COMNAVCOM--now known as Commander, Naval Telecommunications Command, or COMNAVTELCOM--developed the Naval Communications Automation Program Subsystem Project Plan (NCAP SPP) in February, 1969. [7:3-1] While the NCAP SPP was being developed, many changes were taking place in the Department of Defense (DoD) that would impact on the Navy's automation plans. Policy decisions were made to the effect that all future costs would have to be considered in the conceptual and programming phases of any Automatic Data Processing (ADP) or telecommunications systems. Moreover, in 1968, the Secretary of Defense (SEC DEF) added the constraint that all LDMX systems would be justified and approved on a case-by-case basis regardless of cost. [7:3-1] These changes initiated the train of events that determined how analyses of automated sites were made.

Changes were also made in the organization of communications facilities. As the result of a directive issued by the Deputy Secretary of Defense (DEPSECDEF) in April of 1969, telecommunications centers (TCC's) were created by consolidating separate message and communications functions. DEPSECDEF lent further emphasis to this consolidation effort a year later, when he mandated the consolidation of all TCC's within a discrete geographic

area regardless of service or agency affiliation. [5:3-4] These changes were to be reflected in the Navy's future automation plans, but they were not reflected in the initial NCAP SPP, which was approved by CNO in June of 1971.

B. NCAP SPP OBJECTIVES

"The primary objective of the Naval Communications Automation Program is to obtain, on an evolutionary basis, a fully automated naval communications system which satisfies overall requirements such as speed, reliability, security, and equipment compatibility." [4:5-2] In addition to this primary objective, the NCAP SPP cited several specific objectives:

1. To obtain near-real-time exchange of information critical to the command and control of forces afloat through the automation of message processing functions.
2. To provide communications processing, switching, and distribution capabilities required for the exchange of logistic and support information needed to support and maintain force readiness.
3. To achieve the most economical use of resources obtainable only by the automation of communications and information-transfer functions.
4. To obtain the flexibility necessary to maintain critical communications through the selection of transmission media.
5. To reduce supervisory and other manpower requirements by providing automated communications techniques.
6. To use modular design techniques and centralized software control in the interest of equipment standardization and compatibility.

These objectives were published in the original SPP in 1969. When the revised SPP was printed in 1970, the primary objective was unchanged, but specific objectives 3, 4, and 6 had been modified as follows [5:5-2]:

3. To achieve the most cost-effective use of resources through the consolidation of facilities.
4. To obtain maximum utilization of resources, and the flexibility necessary to maintain critical communications, through the automatic selection of transmission media.
6. To use standard modular design and centralized software control in the interest of equipment standardization, compatibility, maintainability, logistic support, and the conservation of resources.

These changes reflected the changes in DoD's approach to the consolidation of facilities, mentioned previously. They also reflect a change in attitudes toward limiting the costs of automation.

In 1972, the SPP was again revised. As before, the primary objective was unchanged, but all of the specific objectives had been modified [6:5-3]:

1. Increased speed of service
2. Accuracy--reduction of the error rate to less than 1% of message traffic handled
3. Security--reduction of security violations to near zero
4. Reliability--reduction of misroutings and non-deliveries to one in ten million
5. Expandability--facilitation of handling up to 8,000 messages per day and satisfying new requirements without major system upgrade or personnel retraining

In short, the specific objectives were no longer global system objectives, but had been restated to provide quantitative detail in support of the overall primary objective.

C. PROGRAM CONCEPT

Although the specific objectives varied between 1969 and 1972, the overall plan for evolutionary implementation did not change. It called for implementation in three phases:

1. Phase I--Initial Automation, 1969-1972

This phase was designed to implement immediate automation in an attempt to alleviate the most pressing problems. Specifically, there was an urgent requirement for automated message entry and format conversion. The first phase was intended as a stopgap measure, to serve until the LDMX/NAVCOMPARS systems were operational. To meet this requirement, off-the-shelf systems were leased, so that costs would be held to a minimum if replacement became necessary upon implementation of LDMX/NAVCOMPARS.

2. Phase II--Interim LDMX/NAVCOMPARS, 1972-1976

This phase included the acquisition and installation of the LDMX/NAVCOMPARS systems. These systems were expected to be updated and expanded in Phase III. "System capability will be monitored, upgraded, and modified as new equipment, software, and additional interface capabilities are developed and naval communications evolves toward the third, fully-automated phase." [6:7-2]

3. Phase III--Full Automation

The concept of Phase III was to provide for a system of LDMX's via standard doctrine, procedures, and formats. The benefits of standard

methods and system functional redundancy were expected to be realized in terms of significant manpower and monetary savings, coupled with increased capacity and efficiency.

D. IMPLEMENTATION OF THE PROGRAM (1971-1976)

In June of 1969, the Special Assistant to the Secretary of the Navy approved the requirements for 14 LDMX systems utilizing RCA Series 70/45 equipment. The NAVCOMPARS was designed to utilize two RCA Series 70/45 systems, and, therefore, the 14 systems were deployed as follows:

TEST BED	Washington Yard
LDMX	OPNAV TCC NTCC Hampton Roads (CINCLANT/CINCLANTFLT) TCC Camp Smith (CINCPAC) NTCC Pearl Harbor (CINCPACFLT) NTCC Crystal Plaza NAVCOMSTA San Diego
NAVCOMPARS	NAVCAMS LANT (Norfolk) NAVCAMS WESTPAC (Guam) NAVCAMS EASTPAC (Honolulu) NAVCAMS MED (Naples)

1. The LDMX

The LDMX systems were designed to automate the shore telecommunications subsystems, and consequently were installed at the NTCC's serving major commands. The LDMX system provides for the automation of [7:5-3]:

a. Routing and formatting of messages

b. Validation, segregation, and transmission of messages

c. Receipting, editing, and internally distributing messages

d. Filing, recalling, or retransmission of messages

e. Readdressing messages

f. Statistics

g. On-line terminations of remote terminals

The LDMX does not provide for automated reproduction and distribution for over-the-counter (OTC) message traffic. Automated OTC distribution is provided for by the Message Processing System (MPS, formerly MRDIS), AN/FSQ-113(V). This system does not automate the reproduction function, in order to take advantage of investment costs previously obligated for existing reproduction devices.

2. The NAVCOMPARS System

This system was designed to automate the fleet-shore interface. In addition to providing for automation of the same functions as the LDMX, it provides the fleet centers with automation of [7:5-3]:

a. Fleet broadcast generation

b. On-line termination of ship-shore circuits

c. Maintenance of a real-time fleet locator

d. Formatting, screening, and distribution via any of several transmission media

With the NAVCOMPARS system, as with the LDMX, OTC distribution is not provided by the system itself. Phase II of the NCAP SPP was completed with the installation of the initial 14 systems by UNIVAC, which had purchased RCA's customer base in 1972.

III. THE NAVAL TELECOMMUNICATIONS AUTOMATION PROGRAM SUBSYSTEMS PROJECT PLAN (FORMERLY NCAP SPP), 1977 TO PRESENT

The period from 1966 to 1976 reflected the perceived urgency of the need for automated telecommunications. It was during this period that programs such as LDMX/NAVCOMPARS and satellite communications flourished. The goal was to automate all aspects of the NTS at almost any cost. But by 1976, changes were starting to occur. At first, communications and message processing functions had been consolidated. Subsequently, multiple TCC's at the same discrete geographical location (i.e., on the same base) had been directed to consolidate. These actions were taken to reduce manpower and overhead costs and to reduce the number of TCC's requiring automation.

Due to austere funding and rising manpower costs, the emphasis on consolidation has increased. Today, the emphasis is on consolidating TCC's in the same geographical area whenever feasible. The shift in emphasis is readily apparent in the current objectives listed in the NTAP SPP.

A. CHANGING GOALS OF THE NTAP SPP

For the reader's reference, the objectives and planning principles of the current NTAP SPP are quoted in full [7:4-1-3]:

> PRIMARY OBJECTIVE
>
> To satisfy existing and future requirements for speed, accuracy, security, and reliability of record information transfer through automation of the NTS in the most economical manner possible.
>
> SPECIFIC OBJECTIVES
>
> a. To enable the NTS to consistently meet the speed of service for record traffic defined in ACP-121 U.S. Supplement (1).

b. To reduce error rates to less than 1% in all message traffic handled and to reduce data error rates, uncorrected, to less than one part in 10^5.

c. To allow the NTS to satisfy future requirements for real time connectivity between processors for information exchange of all types including data, graphics, etc. between commanders, ships, and landing forces worldwide.

d. To provide an effective interface with a connectivity to the Navy Command Control System (NCCS), the National Military Command System (NMCS), the Defense Communications System (DCS) including AUTODIN I and AUTODIN II (Integrated Data Network (IDN)), tactical systems and other systems as the need arises.

e. To provide a capability to effect consolidation of telecommunications facilities and functions within the Navy Department, as well as between military services, to allow reduction in dedicated communications requirements.

f. To eliminate the current slow and error-prone manual functions and to allow more efficient utilization of personnel resources, with a goal of improving speed of service, despite increasing traffic volumes.

g. To provide the flexibility, reliability, capacity and throughput speed required to effectively utilize improved transmission media such as FLTSATCOM and AUTODIN and to provide more efficient operation during crisis situations.

h. To reduce communication functions performed and minimize equipment installed aboard ship.

PLANNING PRINCIPLES

a. Hardware and software will be developed on a modular basis to allow installation of only those components required to meet the specific requirements at each location.

b. Hardware and software development will make maximum utilization of standard equipment, state-of-the-art technology and standard off-the-shelf equipment and standard or otherwise available software to minimize development costs and reduce training and maintenance costs to the minimum.

c. Hardware and software development and procurement will ensure compatibility between all subsystems of the NTS and any other systems to which that subsystem will interface.

d. Effective system/node quality monitoring and control and management capability will be an integral part of the system.

e. Development of automated systems aboard ships and aircraft and the development of the Fleet/Shore Interchange Subsystem will be accomplished in such a manner as to perform the maximum number of functions possible ashore so as to minimize equipment requirements aboard ships and aircraft.

f. Consideration will be given to reducing multiplicity of sophisticated terminals and terminal features by the use of relatively simple input/output terminals operating under control of a host processing system.

g. Systems will be user-transparent to provide maximum usability with minimum training.

h. Existing communications doctrine and procedures will be modified to take better advantage of automated telecommunications systems.

i. Maximum advantage will be made of existing or planned National, DOD, Joint and Allied common user systems to reduce Navy life cycle costs.

j. Navy systems, to the maximum extent possible, will provide a single end-to-end service to support both the GENSER and SI communities.

From an examination of this document, it becomes apparent that a great deal has changed in comparison with the earlier objectives of the NCAP SPP, discussed in the previous chapter. A greater emphasis is placed on consolidation, economy, and the concept of full automation. Of particular significance is the addition of the phrase "in the most economical manner possible" to the primary objective. No longer is automation the only goal; it is now tempered by considerations of effective utilization of people, equipment, and dollars. The emphasis has shifted to purchasing the most appropriate automation for the dollar. In response to this emphasis, the major programs of the NTAP SPP for automation ashore are the LDMX and Remote Information Exchange Terminal (RIXT) programs.

B. THE LDMX/NAVCOMPARS PROGRAM

The LDMX automation program first became operational with the acceptance of the OPNAV TCC LDMX system in December of 1971. As mentioned previously, 14 LDMX systems were purchased and installed to create six LDMX sites at NTCC's serving major commands and four NAVCOMPARS systems at the Naval Communications Area Master Stations (NAVCAMS). In 1976, recognizing the need for increased processing speeds and capabilities in the NAVCOMPARS, procurement action was initiated to purchase the UNIVAC 90/60 system for installation at the following sites [1:8]:

TEST BED	Naval Telecommunications System Integration Center (NAVTELSYSIC)
LDMX	Naval Communications Unit (NAVCOMMUNIT), London
NAVCOMPARS	NAVCAMS LANT (Norfolk) NAVCAMS EASTPAC (Honolulu) NAVCAMS WESTPAC (Guam) NAVCAMS MED (Naples) NAVCOMSTA STOCKTON (California)

Installation of the UNIVAC 90/60 at the four NAVCAMS will release eight LDMX UNIVAC 70/45 systems for reutilization. On September 6, 1978, the Assistant Secretary of the Navy (Financial Management) approved the reutilization of these eight systems. [1:8] As a result, LDMX systems have been installed at [7:5-5]:

NTCC Bangor
NTCC North Island
NTCC Roosevelt Roads
NTCC Charleston

and are scheduled to be installed at [1:9]:

MTCC Camp LeJeune
NTCC Jacksonville
NTCC Breezy Point
NSA New Orleans

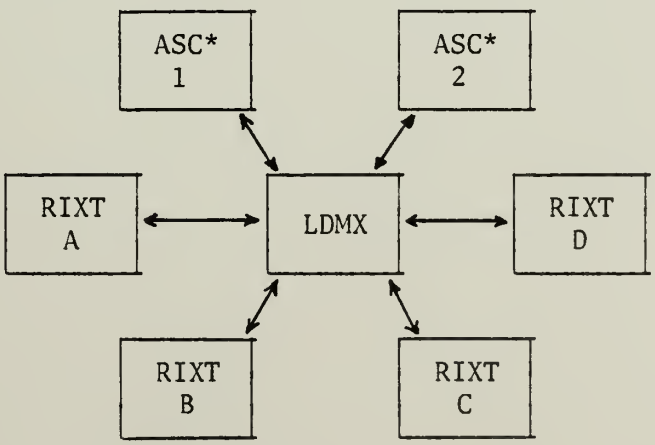
This action has met the dual need for additional LDMX systems and increased capabilities of the NAVCOMPARS in compliance with the NTAP SPP objective of automation in the most economical manner possible.

C. THE RIXT PROGRAM

In striving to reach its goal of full automation, the Navy established the RIXT program. This system provides the automated capabilities of the host LDMX/NAVCOMPARS electronically to TCC's in the same geographical location, thus providing mainframe computer system capabilities to TCC's whose requirements do not justify installation of an LDMX. [7:5-5] The automated capabilities extended by the RIXT include message entry, logging, file and retrieval, distribution assignment and update, message transmission, duplicate search, and special handling.

D. SYSTEM CONCEPT

Below is a simple block diagram of the interface between the LDMX and the RIXT, and between the LDMX and the Automatic Digital Network (AUTODIN):



*Automated Switching Center--a node within the AUTODIN network

All traffic destined for, or transmitted from, the RIXT installations must be processed through the host LDMX system. Because of this relationship, any computer failure at a host LDMX site will cause a reciprocating outage at its satellite RIXT TCC's. Another relationship between the LDMX and the RIXT involves the message processing functions assumed by the LDMX. These functions require LDMX personnel to perform supporting duties such as updating RIXT internal distribution and routing files, or manually intervening to correct non-standard traffic to or from the RIXT. In light of these relationships, it seems clear that the LDMX and its attached RIXT(s) constitute a system, over which, for the purposes of analysis, all benefits and costs should be spread. The term "LDMX total system," as used henceforth, should be understood in this context.

IV. COST-EFFECTIVENESS METHODOLOGY FOR AUTOMATION OF COMMUNICATIONS

The current emphasis on providing automation in the most economical manner possible makes manifest the need for a relevant, practical, and comprehensive cost-effectiveness methodology. There being no such methodology documented in the existing literature, the author has developed one. It will be presented in this chapter.

A. EFFECT OF THE CHANGE IN PRIMARY OBJECTIVE

The original primary objective of the NTAP SPP stressed the concept of automation at all costs. Over the years, this approach has been considerably moderated; the present concept is automation in the most economical manner possible. This philosophy is one of the most important single considerations in the analysis of potential sites for automation. Automation is most cost-effective when the sites being automated process large volumes of traffic. The underlying reason for this is that the processing of large volumes of traffic in a manual or semi-automated TCC is highly manpower-intensive. Therefore, in upgrading the TCC to an automated operation, manpower may be reduced. If, however, the volume of traffic processed by a manual or semi-automated TCC is relatively low, then manpower levels will also in all likelihood be low, and implementing an automated system may actually increase manpower costs.

Another fundamental reason for the association of large message volume with increased cost-effectiveness after automation springs from the relationship of traffic volume to other effectiveness measures, notably

reliability, speed of service, and accuracy. In a semi-automated or manual TCC operation, as the volume of traffic processed increases, these effectiveness measures inevitably diminish, and conversely, as volume peaks and then falls off, the reliability, speed, and accuracy of the operation tend gradually to improve. Automation of large-volume TCC operations thus makes sense from the point of view of all effectiveness measures.

A third and more subtle reason for automating large-volume TCC's is that they tend, very naturally, to be associated with major commands, and major commands, in relation to other activities, generate a higher proportion of critical, time-sensitive command and control traffic. This, indeed, was the concept used to identify sites for installation of the initial LDMX's. At a major command, there is inevitably a large volume of traffic, with a greater chance that the traffic includes a significant percentage of critical messages.

Because high message volume is positively correlated with all of the benefits to be derived from automation, it is recommended that, in extreme cases of exceptionally low volume, if consolidation of facilities is not feasible for geographical or other reasons, the burden of persuasion for automation be placed upon the activity involved. There may be some few small TCC's whose messages are very infrequent but very vital--so vital that even the possibility of human error must be avoided. In the vast majority of cases, however, the situation is apt to be just the reverse. If an operation is economically marginal to begin with, its existence may nonetheless be justifiable on military grounds, but its expansion, by means of major capital outlays, is probably not. This concept should be reflected in the primary objective.

B. DEFINITION OF THE SCOPE OF THE ANALYSIS AND ALTERNATIVES

Defining the scope of analysis has to do with the perspectives used in making automation decisions. Because of the specific connectivity objective of the NTAP SPP, decisions should be made on the basis of telecommunications center operations within a defined geographical area. This would allow evaluation of the following alternatives:

1. Whether or not TCC consolidation could be effected;
2. Whether area traffic volumes could support a single LDMX-RIXT configuration with another automated system as its geographical backup; or
3. Whether area traffic volumes could support two LDMX-RIXT systems, with each LDMX total system providing backup to the other (e.g., the Pearl Harbor-Camp Smith configuration).

When the scope of analysis is limited to a site-by-site approach, a full analysis of the need for connectivity within the area is impossible. Another significant drawback of site-by-site analysis is that it does not allow for LDMX total system analysis. As mentioned previously, to ignore the dependent relationships between LDMX and RIXT installations is to ignore the fact that RIXT installations benefit from the LDMX connectivity through lower capital and operating costs, while providing the LDMX with a larger output performance measure to allocate its costs.

In determining the alternatives, it is essential that the primary objective be kept in mind--automation in the most economical manner possible. This does not mean that each geographical area which requires automation should be automated with an LDMX. The LDMX was designed for high-volume OTC traffic and high connectivity. At low traffic volumes, the LDMX is not

cost-effective, in that it requires fairly large outlays for manpower, maintenance, and AUTODIN equipment and circuits. Other automated or semi-automated alternatives, such as AUTODIN terminals or Standard Remote Terminals (SRT), should be considered in order to meet the primary objective of economical automation.

C. THE PROCEDURE

The methodology formulated here provides decision-makers with the most complete and relevant information available, in order that they will be better able to make intelligent and justifiable decisions.

1. Determining Alternatives

The initial step in this methodology is to identify all viable options to be considered. Any analysis which excludes one or more feasible solutions may lead to the presentation of incomplete data, and may, in the worst case, fail to consider the best possible solution.

In evaluating alternatives for any given site, it is best to evaluate in light of the needs and capabilities of other facilities within the same area. Therefore, a geographical area should be well-defined, and all communications facilities within that area should be identified and evaluated as to their present operations. Data compiled for each site should include traffic records, reliability figures, accuracy figures, speed of service figures, annual operating costs, anticipated recurring costs, and all manpower-related costs. Based upon this information, all sites can be placed into one of three categories: (1) sites not requiring automation based on *a priori* considerations, though they may be considered for consolidation if that is a feasible alternative; (2) sites constituting

either the primary or the back-up facility of an area--in other words, one of the area's two largest-volume facilities; or (3) remaining sites.

Actual determination of alternatives is based on the message volume of the area as a whole. If message volumes are very low, it would be foolish to consider multiple LDMX sites, and, conversely, if the area message volume is quite high, it is impractical to exclude automation by means of LDMX from the alternatives. The alternatives must be presented on an area basis. For example:

Alternative 1--Retain all present systems.

Alternative 2--Automate the primary site with other than LDMX hardware; retain all other sites as is.

Alternative 3--Automate the primary site with LDMX, automate the backup site with SRT, automate sites C, D, F, G, I, and K with RIXT, and retain all other sites as is.

Alternative 4--Automate the primary and backup sites with LDMX, automate sites A, B, C, F, and G with RIXT homed to the primary site, and automate sites D, E, H, and I with RIXT homed to the backup site.

These examples are not exhaustive, but they illustrate the area approach, and allow consideration of the effects of the various alternatives on a geographical basis. This becomes very important when considering the LDMX/RIXT configuration. If each site is analyzed individually, the supporting nature of the connectivity among sites may not be recognized, or its full impact may not be appreciated.

2. Evaluating Costs and Benefits/Effectiveness

Once the alternatives are determined--including the baseline alternative, which is to retain the current system--comparisons may be

made among the alternatives with regard to specific categories of compiled data. The cost data for all alternatives is most easily dealt with when presented in terms of present-year dollars. In accordance with standard government procedure, these cost figures must be presented as present-value life cycle costs.

This methodology uses incremental cost to evaluate the alternatives. For example, if Alternative 1, the baseline alternative, already costs x dollars, we would seek to determine and quantify the increase in benefits resulting from the expenditure of y dollars to implement Alternative 2. We would then do likewise with regard to the expenditure of z dollars to implement Alternative 3, and so forth. In order to prepare this last part of the analysis, the incremental increases in benefits--such as speed of service, reliability, and accuracy--must be computed for each alternative and compared to the baseline alternative. Finally, these incremental figures are related to the incremental costs of implementing the various alternatives.

3. Comparing Costs/Benefits of Alternatives and Rank Ordering

The comparison of the costs and benefits associated with each alternative is an important part of any economic analysis. What we seek is the following type of reasoning: If Alternative 3 is selected, then reliability can be increased by a factor a at an incremental cost of b dollars, whereas if Alternative 4 is implemented, it will increase reliability by a factor c at a cost of d dollars. The whole purpose of the comparisons is to develop data to aid decision-makers. Rank ordering of the data facilitates the decision-making process. Any means of rank ordering which provides a relevant assessment of the data should be utilized.

Two such approaches might be rank ordering by least cost, and rank ordering by greatest incremental increase in benefit derived, for each of the benefit measures. From such data, decision makers will be best able to determine what tradeoffs are involved for each alternative, and will thus be able to make the most cost-effective allocations of limited resources.

V. EVALUATION OF TWO PROPOSED LDMX TOTAL SYSTEMS

Inter-Service Agency Extension of Automation Feasibility Studies were conducted on the Norfolk and New Orleans areas in August of 1980. Not all communications facilities in the area were analyzed. Rather, analysis was limited to those naval facilities in the area which were not already automated, together with the facilities of any other service or Defense agency which wished to be considered. The analysis examined which TCC's should be connected to the LDMX scheduled to be installed in each area. With respect to each TCC, the alternatives considered were: to retain the present system, to install a RIXT configuration, or to consolidate with another local TCC. The capital, traffic, and cost data developed by these studies were used in the preparation of Appendices A through D.

These studies did not quantify the benefits expected to be derived from automation, nor did they evaluate the option of automating with other than LDMX hardware. Because of the limitations of the scope (not all TCC's considered) and the lack of quantification of benefits in the studies, an evaluation of these two sites cannot be made in accordance with the methodology developed in the preceding chapter. Evaluation will be as complete as possible, given the data available.

A. NTCC BREEZY POINT

1. Determining Alternatives

Table V-1, below, lists the communications facilities considered to be in the Norfolk geographical area. The status of each facility is also

given: currently automated, candidate for automation, or not recommended for automation "in view of low traffic volume and high cost." [6:ii] The study does not specifically delineate the geographical area in question, nor does it specifically state that all of the local communications facilities are listed.

TCC LOCATION	STATUS
HQ, Commander in Chief, U.S. Atlantic Fleet	Automation complete. Not included in the study.
HQ, Commander, Submarines Atlantic	Same
HQ, Commander, Oceanographic Systems Atlantic	Same
NTCC Hampton Roads	Same. LDMX equipped. Extends automation to the preceding TCC's.
HQ, Commanding General, Fleet Marine Forces Atlantic	Automation approved and scheduled for FY81. Not included in study.
NTCC Breezy Point	Candidate is evaluated in study, recommended for automation by installing LDMX. Programming approved for FY82.
Naval Supply Center, Norfolk, Virginia	Candidate evaluated in study and recommended for automation. Programming approved for FY82.
Naval Air Station, Oceana, Virginia	Same
NTCC Portsmouth, Virginia	Same
Naval Weapons Station, Yorktown, Virginia	Same
Coast Guard District Five, Portsmouth, Virginia	Candidate evaluated in study; automation recommended.

Table V-1

TCC LOCATION	STATUS
Coast Guard Air Station, Elizabeth City, North Carolina	Candidate evaluated in study. Automation not recommended in view of low volume traffic and high cost.
Adjutant General, Virginia National Guard, Richmond, Virginia	Same
U.S. Army Corps of Engineers, Norfolk, Virginia	Same
Fort Story Element, U.S. Army Communications Command, Fort Eustis, Virginia	Same

Table V-1 (cot'd.)

It is impossible to determine which are the primary and backup facilities, since the sites previously automated are not analyzed in the study. This, in turn, makes it impossible to determine whether certain alternatives are valid. For example: Is the LDMX at NTCC Hampton Roads able to support additional RIXT's? Can the total message volume of the geographical area support two LDMX installations? Should the planned RIXT installation be connected to the proposed LDMX at NTCC Breezy Point, or to the existing one at NTCC Hampton Roads?

An additional limitation of the data in the feasibility study lies in its failure to address multiple alternatives. The questions of whether or not to consolidate, and whether or not to automate, were addressed, but the question of what type of equipment to use in automating was not even asked. As a result, only data relating to existing systems, and to LDMX/RIXT installations, were presented.

Ideally, the feasibility study would have delineated the Norfolk geographical area, and would have given a complete list of the communications facilities located therein, regardless of service or Defense agency affiliation. Furthermore, complete information as to current operating costs, manpower costs, non-recurring costs, traffic data, subscriber data, and performance data should have been presented for every communications facility, without exception. Based on this information, alternatives could have been presented as to what the cost and performance impact would have been for each site if it were to be consolidated, to remain unchanged, or to be fully or semi-automated.

2. Evaluating Costs and Benefits/Effectiveness

The feasibility study presented the costs for FY80-FY84 in FY80 dollars. The period of consideration was set at five years in order to coincide with the Five Year Defense Program. Costs were presented on a yearly basis, and, with the exception of a two-alternative cost comparison in the executive summary, life cycle costs were not computed. In addition, in the preparation of the executive summary figures, annual costs were merely summed, rather than being discounted for FY81 through FY 84 and presented as present value life cycle costs (PVLCC).

Under the methodology proposed here, PVLCC would be computed for each alternative, using the equation

$$PVLCC = C_{80} + \frac{C_{81}}{(1+.1)^1} + \frac{C_{82}}{(1+.1)^2} + \frac{C_{83}}{(1+.1)^3} + \frac{C_{84}}{(1+.1)^4} + \frac{C_{85}}{(1+.1)^5} \quad ,$$

where C_n represents the cost in year n.

The discount figure of 10% was used in accordance with DoD Inst. 7041.3.* Because the LDMX is currently scheduled for replacement in FY85 by the Inter Service/Agency Automated Message Processing Exchange (IS/A AMPE), the life cycle used is FY80 through FY85. In all probability, the system will be in place much longer, but this possibility is not documented, so the life cycle must be limited to these years.†

For the proposed RIXT installations as a group, the PVLCC was $9,056.0K for remaining unchanged, and $9,335.4K for automating. This represents an incremental cost of $279.4K. (See Table V-2.) For the LDMX total system, the PVLCC for the baseline alternative was $14,359.1K as opposed to $16,849.0K for automation, representing an incremental cost of $2,309.9K. (See Table V-3.) Data for alternatives other than LDMX/RIXT were not provided, and therefore PVLCC for alternatives such as SRT or Standard AUTODIN Terminals (SAT) are not presented.

In evaluating each alternative, separate consideration must be given to each benefit derived. The output and effectiveness measures (i.e., total messages, reliability, accuracy, and speed of service) must be evaluated on an individual basis. The data should be presented in terms of incremental benefit derived versus incremental cost. These incremental changes in effectiveness and cost are measured with respect to the baseline alternative, which represents current, non- or semi-automated communications facility operations.

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*Sensitivity analysis was conducted using 5% and 15% rates, but the results did not change the evaluation.

†Sensitivity analysis of the planning range was not conducted due to the lack of data concerning capital and operating costs beyond FY85.

NTCC BREEZY POINT RIXT

	FY80	FY81	FY82	FY83	FY84	FY85	TOTAL
NON-RECURRING COSTS							
Alternative 1							
FY80 $	47.7	37.6	96.0	--	--	--	181.3
Present Value	47.7	34.2	79.3	--	--	--	161.2
Alternative 2							
FY80 $	--	--	904.4	79.2	--	--	983.6
Present Value	--	--	747.4	59.5	--	--	806.9
RECURRING COSTS							
Alternative 1							
FY80 $	275.3	275.3	275.3	275.3	275.3	275.3	1,651.8
Present Value	275.3	250.3	227.5	206.8	188.0	170.9	1,318.8
Alternative 2							
FY80 $	275.3	275.3	265.1	265.1	265.1	265.1	1,611.0
Present Value	275.3	250.3	219.1	199.2	181.1	164.6	1,289.6
MANPOWER COSTS							
Alternative 1							
FY80 $	1,581.4	1,581.4	1,581.4	1,581.4	1,581.4	1,581.4	9,488.4
Present Value	1,581.4	1,437.6	1,306.9	1,188.1	1,080.1	981.9	7,576.0
Alternative 2							
FY80 $	1,581.4	1,581.4	1,464.4	1,464.4	1,464.4	1,464.4	9,020.4
Present Value	1,581.4	1,437.6	1,210.2	1,100.2	1,000.2	909.3	7,239.9
TOTAL COSTS							
Alt. 1 (Pres. Val.)	1,904.4	1,722.1	1,613.7	1,394.9	1,268.1	1,152.8	9,056.0
Alt. 2 (Pres. Val.)	1,856.7	1,687.9	2,176.7	1,358.9	1,181.3	1,073.9	9,335.4
Inc. Cost (2 - 1)	(47.7)	(34.2)	563.0	(36.0)	(86.8)	(78.9)	279.4

Table V-2
(Costs in K Dollars)

NTCC BREEZY POINT TOTAL SYSTEM

	FY80	FY81	FY82	FY83	FY84	FY85	TOTAL
NON-RECURRING COSTS							
Alternative 1							
FY80 $	47.7	37.6	96.0	--	--	--	181.3
Present Value	47.7	34.2	79.3	--	--	--	161.2
Alternative 2							
FY80 $	--	270.0	230.6	79.2	--	--	2,655.2
Present Value	--	245.5	1,905.8	59.5	--	--	2,210.8
RECURRING COSTS							
Alternative 1							
FY80 $	461.2	461.2	461.2	461.2	461.2	461.2	2,767.2
Present Value	461.2	419.3	381.2	346.5	315.0	286.4	2,209.6
Alternative 2							
FY80 $	461.2	461.2	580.4	590.3	590.3	590.3	3,273.7
Present Value	461.2	419.3	479.7	443.5	403.2	366.5	2,573.4
MANPOWER COSTS							
Alternative 1							
FY80 $	2,540.0	2,540.0	2,540.0	2,540.0	2,540.0	2,540.0	15,240.0
Present Value	2,540.0	2,309.0	2,099.0	1,908.3	1,734.9	1,577.1	12,168.3
Alternative 2							
FY80 $	2,540.0	2,540.0	2,504.0	2,504.0	2,504.0	2,504.0	15,096.0
Present Value	2,540.0	2,309.0	2,069.4	1,881.3	1,710.3	1,554.8	12,064.8
TOTAL COSTS							
Alt. 1 (Pres. Val.)	3,048.9	2,762.5	2,559.5	2,254.8	2,049.9	1,863.5	14,539.1
Alt. 2 (Pres. Val.)	3,001.2	2,975.8	4,454.9	2,384.3	2,113.5	1,921.3	16,849.0
Inc. Cost (2 - 1)	(47.7)	211.3	1,895.4	129.5	63.6	57.8	2,309.9

Table V-3
(Costs in K Dollars)

3. Comparing Costs/Benefits of Alternatives and Rank Ordering

An important part of an economic analysis is a comparison of the costs of each alternative with the benefits derived from it. The feasibility study only presents a comparison of annual costs. Since the benefits assumed to be derived from automation--increased reliability, speed of service, accuracy, etc.--are not quantified for each alternative, comparisons cannot be made.

Using the proposed methodology, comparisons can be made. For example, if an LDMX is installed at NTCC Breezy Point, 5,643K messages will be processed for 34 commands at one automated site for an incremented PVLCC of $2,616.6K. (See Table V-4). This statement of quantitative fact can be contrasted with a quantitative statement concerning another alternative, with its own impact on volume, subscribers, sites, and incremental PVLCC. The methodology only presents facts; it does not make the decisions. However, these facts should be presented in such a manner as to facilitate the making of a decision. Since the objective is to provide automation in the most economical manner possible, rank ordering of the data is essential to the decision-making process. It is not possible to do this in Table V-4, however, due to the non-consideration of alternatives and non-availability of data concerning effectiveness measures.

NTCC BREEZY POINT
Life Cycle Evaluation Data

	Other Automated System	LDMX	RIXT	LDMX Total System
Total Messages (FY80 through FY 85)	N/A	6,047.0K	11,127.0K	17,174.0K
Total Subscribers Served	N/A	60	109	169
Total Sites Automated	N/A	1	5	6
Incremental Improvement in Speed of Service	N/A	N/A	N/A	N/A
Incremental Improvement in Reliability	N/A	N/A	N/A	N/A
Incremental Improvement in Accuracy	N/A	N/A	N/A	N/A
Incremental PVLCC	N/A	$2,030.5K	$279.4K	$2,309.9K

Table V-4

B. NTCC NSA NEW ORLEANS

1. Determining Alternatives

The feasibility study for the New Orleans area was done following the same basic model as was used for the Norfolk area study. It suffers from the same limitations. Although Table V-5 lists the activities considered to be within the New Orleans area, uncertainty exists as to the exact limits of the area. and it is impossible to determine whether all facilities in the geographical area are included in the list.

The data compiled is essentially the same as for the NTCC Breezy Point study. It consists of easily quantifiable data such as costs, traffic volumes, and subscriber data. Effectiveness measures--reliability, accuracy, speed of service--are not included in the tabulation. As in the Breezy Point study, there were several sites not considered, either because they were already automated or because they requested not to be considered. Eliminating these sites from evaluation makes it difficult to determine how much automation, and what means of automation, the "New Orleans area" can support. The insufficient data makes it impossible to determine all feasible alternatives. For example, the idea of consolidating some of the smaller TCC's with NTCC New Orleans DET Bay St. Louis, Mississippi cannot be analyzed, because data pertaining to that site were not presented. Ideally, as mentioned above, complete data for all sites within the relevant geographical area would have been presented, so that multiple alternatives for each site might have been analyzed.

TCC LOCATION	RECOMMENDATION
NTCC NSA (East Bank) New Orleans	Automate with LDMX in FY82.
NTCC NAS Belle Chasse	Automate with RIXT B in FY82.
NTCC NSA (West Bank)	Semi-automate with ECC in FY82.
NTCC New Orleans DET Bay St. Louis MS	Continue consolidated SI/GENSER TCC operations.
TCC 159th Tactical Fighter Group	Close TCC and consolidate with NTCC NAS Belle Chasse
TCC Army National Guard, Camp Shelby	No change.
TCC Army Corps of Engineers, LMVD Vicksburg, Mississippi	Automate with RIXT C.
TCC 2052nd Comm Squadron, Keesler AFB, Biloxi, Mississippi	None. Deleted as a candidate IAW HQ AFCC request.
NTCC Construction Battalion Center, Gulfport, Mississippi	Continue current plans to upgrade with SRT homed to ASC. Convert to automation by rehoming to LDMX when available.
TCC Superintendent of Ships, Pascagoula, Mississippi	Continue current plans for SRT homed to ASC to provide redundant interconnect to the area.
TCC Corps of Engineers, Mobile, Alabama	No change.
TCC US Coast Guard District 8, New Orleans	Continue current plans to upgrade with SRT SAT II and install ECC with NAVSUPPACT (EB) for mutual ASC altroute.
TCC Louisiana National Guard	No change.
TCC ACE New Orleans	No change.
TCC ACE (WES), Vicksburg	No change.
TCC Waterborne Commerce Stat.	No change.

Table V-5

2. Evaluating Costs and Benefits/Effectiveness

With the exception of one site, the alternatives presented by the feasibility study fell into two categories: not to automate, or to automate with an LDMX/RIXT configuration. One site was considered for an Electronic Courier Circuit (ECC), but even that alternative was dependent upon the installation of the LDMX. This alternative cannot be evaluated here, since the cost is the same for the same volume, and effectiveness measures are unknown.

The costs delineated in the feasibility study were projected on an annual basis over the period FY80 through FY84 in order to coincide with the Five Year Defense Program. However, in the executive summary, the project was evaluated on the basis of an eight-year economic life. In addition, the total annual costs were discounted at a real rate and then inflated. This approach is in conflict with the preferred method, which is either to effect discounting and inflation simultaneously, using nominal rates, or only to discount, at the real rate. It is not essential that the PVLCC be inflated for the evaluation of alternatives. The inflation calculation is not essential when comparing alternatives in the planning stage, provided that inflation has no differential effect on the relative costs incurred over the life cycle of the system.

The equation presented in A.2., above, was also used here to determine the PVLCC for the alternatives of maintaining the current operation, or installing the LDMX/RIXT. In this particular instance, the cost of Alternative 1 for the RIXT installations is $2,204.5K versus $2,585.1K for an incremental cost of $380.6K. (See Table V-6.) For the LDMX total system, incremental cost comes to $2,997.2K. (See Table V-7.) Again, each effectiveness measure must be considered separately.

NTCC NSA (EB) NEW ORLEANS RIXT INSTALLATIONS

	FY80	FY81	FY82	FY83	FY84	FY85	TOTAL
NON-RECURRING COSTS							
Alternative 1							
FY80 $	47.7	37.6	96.2	--	--	--	181.5
Present Value	47.7	34.2	79.5	--	--	--	161.4
Alternative 2							
FY80 $	--	--	643.5	--	--	--	643.5
Present Value	--	--	531.8	--	--	--	531.8
RECURRING COSTS							
Alternative 1							
FY80 $	81.2	81.2	84.6	84.6	84.6	84.6	500.8
Present Value	81.2	73.8	69.9	63.6	57.8	52.6	398.9
Alternative 2							
FY80 $	81.7	81.7	87.8	87.8	87.8	87.8	514.6
Present Value	81.7	74.3	72.6	66.0	60.0	54.5	409.1
MANPOWER COSTS							
Alternative 1							
FY80 $	343.2	343.2	343.2	343.2	343.2	343.2	2,059.2
Present Value	343.2	312.0	283.6	257.9	234.4	213.1	1,644.2
Alternative 2							
FY80 $	343.2	343.2	343.2	343.2	343.2	343.2	2,059.2
Present Value	343.2	312.0	283.6	257.9	234.4	213.1	1,644.2
TOTAL COSTS							
Alt. 1 (Pres. Val.)	472.1	420.0	433.0	321.5	292.2	265.7	2,204.5
Alt. 2 (Pres. Val.)	424.9	386.3	888.0	323.9	294.4	267.6	2,585.1
Inc. Cost (2 - 1)	(47.2)	(33.7)	455.0	2.4	2.2	1.9	380.6

Table V-6
(Costs in K Dollars)

NTCC NSA (EB) NEW ORLEANS LDMX TOTAL SYSTEM

	FY80	FY81	FY82	FY83	FY84	FY85	TOTAL
NON-RECURRING COSTS							
Alternative 1							
FY80 $	47.7	37.6	96.2	--	--	--	181.5
Present Value	47.7	34.2	79.5	--	--	--	161.4
Alternative 2							
FY80 $	--	--	1,817.9	--	--	--	1,817.9
Present Value	--	--	1,503.3	--	--	--	1,503.3
RECURRING COSTS							
Alternative 1							
FY80 $	240.6	240.6	240.6	240.6	240.6	240.6	1,443.6
Present Value	240.6	218.7	198.8	180.8	164.3	149.4	1,152.6
Alternative 2							
FY80 $	241.1	241.1	359.7	359.7	359.7	359.7	1,921.0
Present Value	241.1	219.2	297.3	270.2	245.7	223.3	1,496.8
MANPOWER COSTS							
Alternative 1							
FY80 $	1,065.0	1,065.0	1,065.0	1,065.0	1,065.0	1,065.0	6,590.0
Present Value	1,065.0	968.2	880.2	800.2	727.4	661.3	5,102.3
Alternative 2							
FY80 $	1,065.0	1,065.0	1,520.0	1,520.0	1,520.0	1,520.0	8,210.0
Present Value	1,065.0	968.2	1,256.2	1,142.0	1,038.2	943.8	6,413.4
TOTAL COSTS							
Alt. 1 (Pres. Val.)	1,353.3	1,221.1	1,158.5	981.0	891.7	810.7	6,416.3
Alt. 2 (Pres. Val.)	1,306.1	1,187.4	3,056.8	1,412.2	1,283.9	1,167.1	9,413.5
Inc. Cost (2 - 1)	(47.2)	(33.7)	1,898.3	431.2	392.2	356.4	2,997.2

Table V-7
(Costs in K Dollars)

3. Comparing Costs/Benefits of Alternatives and Rank Ordering

As in the case of the Norfolk area study, all relevant alternatives are not presented, and therefore a comparison of costs and benefits for each alternative is not possible. Table V-8 presents the facts that are describable, and indicates how alternatives could be considered as statements. For example: If RIXT installations are implemented, 1,388K messages will be processed for 50 commands at three sites for an incremental cost of $380.6K. This statement could be compared to other statements based on different alternatives for the same sites. In addition, data concerning the improvement in effectiveness measures, and their associated PVLCC, could be compared and rank ordered.

C. OTHER CONSIDERATIONS

Very little has been said concerning the subscribers served by the TCC's. The methodology can do little more than present, for consideration by decision-makers, the number of subscribers and their missions. The relative importance of each subscriber is not a factor which lends itself to quantification. It must, therefore, be considered on a judgemental basis. However, analysis of the number of subscribers served by a system may give some insight into the degree to which consolidation is being effected. If, in presenting the data concerning the TCC's in a geographical area, it comes to light that there are a number of small TCC's serving a relatively small number of subscribers with low message volumes, consolidation may be indicated.

Another planning principle which may be considered in the analysis is connectivity. Those costs associated with the RIXT's can be considered

NTCC NSA NEW ORLEANS
Life Cycle Evaluation Data

	Other Automated System	LDMX	RIXT	LDMX Total System
Total Messages (FY80 through FY85)	N/A	5,643.0K	1,388.0K	7,031.0K
Total Subscribers Served	N/A	34	50	84
Total Sites Automated	N/A	1	3	4
Incremental Improvement in Speed of Service	N/A	N/A	N/A	N/A
Incremental Improvement in Reliability	N/A	N/A	N/A	N/A
Incremental Improvement in Accuracy	N/A	N/A	N/A	N/A
Incremental PVLCC	N/A	$2,616.6K	$380.6K	$2,997.2K

Table V-8

connectivity costs primarily because they allow the RIXT's subscribers access to the major systems, such as WWMCCS or NCS, which interface with the LDMX. In Tables V-4 and V-8, RIXT-related costs were presented aside from total system costs in order that the decision-maker be better able to decide whether the benefit of connectivity is worth the cost.

The interdependent relationship between the LDMX and the RIXT should be considered in evaluating the LDMX total system. The RIXT receives much benefit from the connectivity to the LDMX at a substantially lower capital and receiving cost than the installation of a stand-alone system. In turn, the LDMX achieves a larger base of operations over which to spread its costs. If the RIXT facilities do not provide a large enough message volume, then overall savings in manpower and recurring costs will not occur. (See Section II.D.)

This concept can best be evaluated by analyzing the alternatives affecting the RIXT installations as a group. As can be seen in Table V-2, actual savings occur in FY83-85, to the amount of $201.7K. In applying the total system concept, the savings are applicable to the system as a whole, because, without the LDMX, these savings would not have occurred. It is important to note that, while these savings benefit the DoD budget, they may not affect the Navy budget, depending upon the service affiliation of the TCC incurring the savings.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

Events in the mid-sixties caused a revolution in the field of military communications. For many years previous to this time, little innovation and technical change had taken place. As a result of the fleet exercise BASELINE II and decisions made subsequent to it, great strides were made in providing state-of-the-art automation to all communications facilities regardless of cost. After the first phase of implementation of this policy, when all major TCC's and NAVCAMS were automated, the main thrust of automation shifted somewhat, and the Navy decided to provide for the automation of NTS in the most economical manner possible. The fundamental decision to provide complete automation for communications facilities, a decision which was made in the mid-sixties, still appears to be the principal objective of naval communications. Somehow, this seems incongruous in light of the changes in operating conditions over the past fifteen years. No longer are major shore communications facilities operated in manual modes. The concept that more automation always provides improvements in effectiveness is subject to challenge. If a TCC processes an inordinately small volume of traffic, automation may not provide any appreciable improvement in reliability, accuracy, or speed of service, yet may drastically increase the manpower and other operating costs. A change needs to be made to the primary objective, recognizing that automation of the NTS is not absolute--that there are other alternatives.

The method of analysis of TCC's used by the Navy today is inadequate, because it fails to deal with other than easily quantifiable data such as traffic volume, recurring and non-recurring costs, and manpower costs. It does not provide sufficient data to enable decision-makers to determine what specific benefits can be achieved at what cost. The feasibility studies also fall short in this respect. Decision-makers are forced to choose between complete automation and little or not automation.

Because of these shortcomings in the current analysis method, it may be difficult to justify some of the decisions which have been made and are being made. For instance, in comparing the LDMX/RIXT configurations to be installed at NSA (EB) New Orleans and at NTCC Breezy Point, this author's analysis shows that NSA (EB) New Orleans can be automated for 30% higher incremental PVLCC in order to process 59% fewer messages, for 50% fewer subscribers, at 33% fewer sites. (See Tables V-4 and V-8.) This does not appear to reflect the philosophy of automation in the most economical manner possible. In the present tight-budget climate, the decision to automate NSA (EB) New Orleans might be very hard to justify on a cost-effectiveness basis.

B. RECOMMENDATIONS

In consideration of austere budgeting and specific objectives in the NTAP SPP, and in order to utilize resources most efficiently, it is strongly recommended that the primary objective of automation of the NTS be further modified to reflect the goal of implementing that degree of automation which is most cost-effective. In conjunction with this change to the primary objective, economic analysis of sites being evaluated must reflect the

specific amounts of improvement expected to be derived. Detailed analysis of the current operating situation will involve expenditure of additional time and funds, but will provide for more efficient use of resources in the long run.

Secondly, the analysis must reflect more than the baseline and one other alternative. Multiple alternatives provide decision-makers with the information necessary to make choices that are more cost-effective and realistic than "all-or-nothing." Projected improvements in effectiveness measures must be included, with proposed costs for each alternative. This allows decision-makers to make comparisons among the various effectiveness measures and costs in order to make choices which fulfill the primary objective.

Based upon the evaluation of the proposed LDMX/RIXT configuration to be installed at NSA (EB) New Orleans, it is recommended that that proposal undergo further study. Utilizing the information available within the feasibility study, it is clear that the incremental PVLCC is not too much greater than the incremental PVLCC of the proposed installation at NTCC Breezy Point, but that the volume of traffic and number of subscribers are significantly lower. The assumption can be made that, since volume underlies the levels of reliability, accuracy, and speed of service, the increase in these measures of effectiveness may not be significant with the implementation of LDMX/RIXT configuration at NSA (EB) New Orleans. In re-evaluating this proposed site, consideration should be given to alternatives other than LDMX/RIXT, as it may occur that the same improvements can be achieved with a lower cost using some other automated system than those considered in the analysis.

APPENDIX A

Cost Data for NTCC Breezy Point and NTCC NSA New Orleans LDMX/RIXT Systems

The cost data for each LDMX and RIXT installation is presented in Tables A-1 through A-13. In each Table, "Alternative 1" refers to the baseline alternative--in other words, maintaining the present system. "Alternative 2" refers to the installation of LDMX or RIXT.

Non-recurring costs include purchase cost, if applicable; installation; acceptance testing; system training/test acceptance; and site preparation. Supplies include administrative consumables, perforated paper tape, magnetic tape, and data cards. Total recurring costs do not include manpower costs.

All cost figures are presented in thousands of dollars. Information is drawn from References 2 and 3.

NTCC BREEZY POINT
COST DATA

	FY80 ALTERNATIVE 1	FY80 ALTERNATIVE 2	FY81 ALTERNATIVE 1	FY81 ALTERNATIVE 2	FY82 ALTERNATIVE 1	FY82 ALTERNATIVE 2	FY83 ALTERNATIVE 1	FY83 ALTERNATIVE 2	FY84 ALTERNATIVE 1	FY84 ALTERNATIVE 2
NON-RECURRING COSTS	--	--	--	270.0	--	904.4	--	--	--	--
RECURRING COSTS										
Supplies	92.8	92.8	92.8	92.8	92.8	92.8	92.8	92.8	92.8	92.8
Repair Parts										
Reproduction	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7
Offline Equip.	31.4	31.4	31.4	31.4	31.4	--	31.4	--	31.4	--
AUTODIN Equip.	6.7	6.7	6.7	6.7	6.7	--	6.7	--	6.7	--
Other	--	--	--	--	--	--	--	--	--	--
TOTAL	89.8	89.8	89.8	89.8	89.8	51.7	89.8	51.7	89.8	51.7
Leases										
AUTODIN Circuits	3.3	3.3	3.3	3.3	3.3	6.6	3.3	6.6	3.3	6.6
LDMX/RIXT Maint.	--	--	--	--	--	145.0	--	145.0	--	145.0
Other	--	--	--	--	--	19.0	--	19.0	--	19.0
TOTAL	3.3	3.3	3.3	3.3	3.3	170.6	3.3	170.6	3.3	170.6
TOTAL RECURRING COSTS	185.9	185.9	185.9	185.9	185.9	315.1	185.9	315.1	185.9	315.1

Table A-1

TCC NAS OCEANA
COST DATA

	FY80		FY81		FY82		FY83		FY84	
	ALTERNATIVE		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE		ALTERNATIVE	
	1	2	1	2	1	2	1	2	1	2
NON-RECURRING COSTS	--	--	--	--	--	350.4	--	--	--	--
RECURRING COSTS										
Supplies	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7	21.7
Repair Parts										
Reproduction	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4
Offline Equip.	--	--	--	--	--	--	--	--	--	--
AUTODIN Equip.	9.1	9.1	9.1	9.1	9.1	--	9.1	--	9.1	--
Other	--	--	--	--	--	--	--	--	--	--
TOTAL	20.5	20.5	20.5	20.5	20.5	11.4	20.5	11.4	20.5	11.4
Leases										
AUTODIN Circuits	3.4	3.4	3.4	3.4	3.4	.8	3.4	.8	3.4	.8
LDMX/RIXT Maint.	--	--	--	--	--	16.5	--	16.5	--	16.5
Other	--	--	--	--	--	--	--	--	--	--
TOTAL	3.4	3.4	3.4	3.4	3.4	17.3	3.4	17.3	3.4	17.3
TOTAL RECURRING COSTS	45.6	45.6	45.6	45.6	45.6	50.4	45.6	50.4	45.6	50.4

Table A-2

NTCC NSC NORFOLK
COST DATA

	FY80 ALTERNATIVE 1	FY80 ALTERNATIVE 2	FY81 ALTERNATIVE 1	FY81 ALTERNATIVE 2	FY82 ALTERNATIVE 1	FY82 ALTERNATIVE 2	FY83 ALTERNATIVE 1	FY83 ALTERNATIVE 2	FY84 ALTERNATIVE 1	FY84 ALTERNATIVE 2
NON-RECURRING COSTS	--	--	--	--	--	350.4	--	--	--	--
RECURRING COSTS										
Supplies	51.6	51.6	51.6	51.6	51.6	43.5	51.6	43.5	51.6	43.5
Repair Parts										
Reproduction	--	--	--	--	--	--	--	--	--	--
Offline Equip.	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3
AUTODIN Equip.	17.7	17.7	17.7	17.7	17.7	--	17.7	--	17.7	--
Other	--	--	--	--	--	--	--	--	--	--
TOTAL	18.0	18.0	18.0	18.0	18.0	.3	18.0	.3	18.0	.3
Leases										
AUTODIN Circuits	5.7	5.7	5.7	5.7	5.7	.2	5.7	.2	5.7	.2
LDMX/RIXT Maint.	--	--	--	--	--	16.5	--	16.5	--	16.5
Other	--	--	--	--	--	--	--	--	--	--
TOTAL	5.7	5.7	5.7	5.7	5.7	16.7	5.7	16.7	5.7	16.7
TOTAL RECURRING COSTS	75.3	75.3	75.3	75.3	75.3	60.5	75.3	60.5	75.3	60.5

Table A-3

TCC YORKTOWN
COST DATA

	FY80 ALTERNATIVE 1	FY80 ALTERNATIVE 2	FY81 ALTERNATIVE 1	FY81 ALTERNATIVE 2	FY82 ALTERNATIVE 1	FY82 ALTERNATIVE 2	FY83 ALTERNATIVE 1	FY83 ALTERNATIVE 2	FY84 ALTERNATIVE 1	FY84 ALTERNATIVE 2
NON-RECURRING COSTS	--	--	--	--	--	350.4	--	--	--	--
RECURRING COSTS										
Supplies	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
Repair Parts										
Reproduction	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
Offline Equip.	4.4	4.4	4.4	4.4	4.4	--	4.4	--	4.4	--
AUTODIN Equip.	.5	.5	.5	.5	.5	--	.5	--	.5	--
Other	1.7	1.7	1.7	1.7	1.7	--	1.7	--	1.7	--
TOTAL	6.7	6.7	6.7	6.7	6.7	.1	6.7	.1	6.7	.1
Leases										
AUTODIN Circuits	2.7	2.7	2.7	2.7	2.7	.7	2.7	.7	2.7	.7
LDMX/RIXT Maint.	--	--	--	--	--	16.5	--	16.5	--	16.5
Other	1.6	1.6	1.6	1.6	1.6	--	1.6	--	1.6	--
TOTAL	4.3	4.3	4.3	4.3	4.3	17.2	4.3	17.2	4.3	17.2
TOTAL RECURRING COSTS	17.9	17.9	17.9	17.9	17.9	24.2	17.9	24.2	17.9	24.2

Table A-4

TCC USCG DISTRICT 5
COST DATA

	FY80 ALTERNATIVE 1	FY80 ALTERNATIVE 2	FY81 ALTERNATIVE 1	FY81 ALTERNATIVE 2	FY82 ALTERNATIVE 1	FY82 ALTERNATIVE 2	FY83 ALTERNATIVE 1	FY83 ALTERNATIVE 2	FY84 ALTERNATIVE 1	FY84 ALTERNATIVE 2
NON-RECURRING COSTS	47.7	--	37.6	--	96.0	--	--	79.2	--	--
RECURRING COSTS										
Supplies	70.7	70.7	70.7	70.7	70.7	65.6	70.7	65.6	70.7	65.6
Repair Parts										
Reproduction	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
Offline Equip.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
AUTODIN Equip.	5.1	5.1	5.1	5.1	5.1	--	5.1	--	5.1	--
Other	--	--	--	--	--	--	--	--	--	--
TOTAL	15.0	15.0	15.0	15.0	15.0	9.9	15.0	9.9	15.0	9.9
Leases										
AUTODIN Circuits	2.7	2.7	2.7	2.7	2.7	.7	2.7	.7	2.7	.7
LDMX/RIXT Maint.	--	--	--	--	--	5.1	--	9.9	--	9.9
Other	--	--	--	--	--	--	--	--	--	--
TOTAL	2.7	2.7	2.7	2.7	2.7	5.8	2.7	10.6	2.7	10.6
TOTAL RECURRING COSTS	88.4	88.4	88.4	88.4	88.4	81.3	88.4	86.1	88.4	86.1

Table A-5

NTCC PORTSMOUTH
COST DATA

	FY80 ALTERNATIVE 1	FY80 ALTERNATIVE 2	FY81 ALTERNATIVE 1	FY81 ALTERNATIVE 2	FY82 ALTERNATIVE 1	FY82 ALTERNATIVE 2	FY83 ALTERNATIVE 1	FY83 ALTERNATIVE 2	FY84 ALTERNATIVE 1	FY84 ALTERNATIVE 2
NON-RECURRING COSTS	--	--	--	--	--	350.4	--	--	--	--
RECURRING COSTS										
Supplies	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6
Repair Parts										
Reproduction	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Offline Equip.	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2
AUTODIN Equip.	12.2	12.2	12.2	12.2	12.2	--	12.2	--	12.2	--
Other	--	--	--	--	--	--	--	--	--	--
TOTAL	18.1	18.1	18.1	18.1	18.1	5.9	18.1	5.9	18.1	5.9
Leases										
AUTODIN Circuits	3.4	3.4	3.4	3.4	3.4	.9	3.4	.9	3.4	.9
LDMX/RIXT Maint.	--	--	--	--	--	16.5	--	16.5	--	16.5
Other	1.0	1.0	1.0	1.0	1.0	--	1.0	--	1.0	--
TOTAL	4.4	4.4	4.4	4.4	4.4	17.4	4.4	17.4	4.4	17.4
TOTAL RECURRING COSTS	48.1	48.1	48.1	48.1	48.1	48.9	48.1	48.9	48.1	48.9

Table A-6

NTCC BREEZY POINT LDMX TOTAL SYSTEM
COST DATA

	FY80 ALTERNATIVE 1	FY80 ALTERNATIVE 2	FY81 ALTERNATIVE 1	FY81 ALTERNATIVE 2	FY82 ALTERNATIVE 1	FY82 ALTERNATIVE 2	FY83 ALTERNATIVE 1	FY83 ALTERNATIVE 2	FY84 ALTERNATIVE 1	FY84 ALTERNATIVE 2
NON-RECURRING COSTS	47.7	--	37.6	270.0	96.0	1401.0	--	79.2	--	--
RECURRING COSTS										
Supplies	269.3	269.3	269.3	269.3	269.3	256.1	269.3	256.1	269.3	256.1
Repair Parts										
Reproduction	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8
Offline Equip.	39.3	39.3	39.3	39.3	39.3	3.5	39.3	3.5	39.3	3.5
AUTODIN Equip.	51.3	51.3	51.3	51.3	51.3	--	51.3	--	51.3	--
Other	1.7	1.7	1.7	1.7	1.7	--	1.7	--	1.7	--
TOTAL										
Leases										
AUTODIN Circuits	21.2	21.2	21.2	21.2	21.2	9.9	21.2	9.9	21.2	9.9
LDMX/RIXT Maint.	--	--	--	--	--	216.1	--	226.0	--	226.0
Other	2.6	2.6	2.6	2.6	2.6	19.0	2.6	19.0	2.6	19.0
TOTAL	23.8	23.8	23.8	23.8	23.8	245.0	23.8	254.9	23.8	254.9
TOTAL RECURRING COSTS	461.2	461.2	461.2	461.2	461.2	580.4	461.2	590.3	461.2	590.3

Table A-7

NTCC NSA NEW ORLEANS
COST DATA

	FY80 ALTERNATIVE 1	FY80 ALTERNATIVE 2	FY81 ALTERNATIVE 1	FY81 ALTERNATIVE 2	FY82 ALTERNATIVE 1	FY82 ALTERNATIVE 2	FY83 ALTERNATIVE 1	FY83 ALTERNATIVE 2	FY84 ALTERNATIVE 1	FY84 ALTERNATIVE 2
NON-RECURRING COSTS	--	--	--	--	--	1174.4	--	--	--	--
RECURRING COSTS										
Supplies	41.4	41.4	41.4	41.4	41.4	41.4	41.4	41.4	41.4	41.4
Repair Parts										
Reproduction	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5
Offline Equip.	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
AUTODIN Equip.	57.0	57.0	57.0	57.0	57.0	--	57.0	--	57.0	--
Other	--	--	--	--	--	--	--	--	--	--
TOTAL	112.5	112.5	112.5	112.5	112.5	55.5	112.5	55.5	112.5	55.5
Leases										
AUTODIN Circuits	5.5	5.5	5.5	5.5	5.5	11.0	5.5	11.0	5.5	11.0
LDMX/RIXT Maint.	--	--	--	--	--	145.0	--	145.0	--	145.0
Other	--	--	--	--	--	19.0	--	19.0	--	19.0
TOTAL	5.5	5.5	5.5	5.5	5.5	175.0	5.5	175.0	5.5	175.0
TOTAL RECURRING COSTS	159.4	159.4	159.4	159.4	159.4	271.9	159.4	271.9	159.4	271.9

Table A-8

NTCC NEW ORLEANS DET BELLE CHASSE
COST DATA

	FY80 ALTERNATIVE 1	FY80 ALTERNATIVE 2	FY81 ALTERNATIVE 1	FY81 ALTERNATIVE 2	FY82 ALTERNATIVE 1	FY82 ALTERNATIVE 2	FY83 ALTERNATIVE 1	FY83 ALTERNATIVE 2	FY84 ALTERNATIVE 1	FY84 ALTERNATIVE 2
NON-RECURRING COSTS	--	--	--	--	--	349.6	--	--	--	--
RECURRING COSTS										
Supplies	4.0	4.0	4.0	4.0	4.0	5.4	4.0	5.4	4.0	5.4
Repair Parts										
Reproduction	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Offline Equip.	1.4	1.4	1.4	1.4	1.4	--	1.4	--	1.4	--
AUTODIN Equip.	4.5	4.5	4.5	4.5	4.5	--	4.5	--	4.5	--
Other	--	--	--	--	--	--	--	--	--	--
TOTAL	17.9	17.9	17.9	17.9	17.9	12.0	17.9	12.0	17.9	12.0
Leases										
AUTODIN Circuits	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
LDMX/RIXT Maint.	--	--	--	--	--	17.1	--	17.1	--	17.1
Other	--	--	--	--	--	--	--	--	--	--
TOTAL	3.0	3.0	3.0	3.0	3.0	20.1	3.0	20.1	3.0	20.1
TOTAL RECURRING COSTS	24.9	24.9	24.9	24.9	24.9	37.5	24.9	37.5	24.9	37.5

Table A-9

TCC 159TH TFG NEW ORLEANS
COST DATA

	FY80 ALTERNATIVE 1	FY80 ALTERNATIVE 2	FY81 ALTERNATIVE 1	FY81 ALTERNATIVE 2	FY82 ALTERNATIVE 1	FY82 ALTERNATIVE 2	FY83 ALTERNATIVE 1	FY83 ALTERNATIVE 2	FY84 ALTERNATIVE 1	FY84 ALTERNATIVE 2
NON-RECURRING COSTS	--	--	--	--	--	--	--	--	--	--
RECURRING COSTS										
Supplies	1.4	1.4	1.4	1.4	1.4	--	1.4	--	1.4	--
Repair Parts										
Reproduction	--	--	--	--	--	--	--	--	--	--
Offline Equip.	--	--	--	--	--	--	--	--	--	--
AUTODIN Equip.	10.3	10.3	10.3	10.3	10.3	--	10.3	--	10.3	--
Other	--	--	--	--	--	--	--	--	--	--
TOTAL	10.3	10.3	10.3	10.3	10.3	--	10.3	--	10.3	--
Leases										
AUTODIN Circuits	2.9	2.9	2.9	2.9	2.9	--	2.9	--	2.9	--
LDMX/RIXT Maint.	--	--	--	--	--	--	--	--	--	--
Other	--	--	--	--	--	--	--	--	--	--
TOTAL	2.9	2.9	2.9	2.9	2.9	--	2.9	--	2.9	--
TOTAL RECURRING COSTS	14.6	14.6	14.6	14.6	14.6	--	14.6	--	14.6	--

Table A-10

TCC LMVD VICKSBURG DISTRICT USA COE VICKSBURG
COST DATA

	FY80 ALTERNATIVE 1	FY80 ALTERNATIVE 2	FY81 ALTERNATIVE 1	FY81 ALTERNATIVE 2	FY82 ALTERNATIVE 1	FY82 ALTERNATIVE 2	FY83 ALTERNATIVE 1	FY83 ALTERNATIVE 2	FY84 ALTERNATIVE 1	FY84 ALTERNATIVE 2
NON-RECURRING COSTS	--	--	--	--	--	248.3	--	--	--	--
RECURRING COSTS										
Supplies	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Repair Parts										
Reproduction	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Offline Equip.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
AUTODIN Equip.	5.1	5.1	5.1	5.1	5.1	9.8	5.1	9.8	5.1	9.8
Other	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8
TOTAL	25.9	25.9	25.9	25.9	25.9	30.6	25.9	30.6	25.9	30.6
Leases										
AUTODIN Circuits	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
LDMX/RIXT Maint.	--	--	--	--	--	--	--	--	--	--
Other	--	--	--	--	--	--	--	--	--	--
TOTAL	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
TOTAL RECURRING COSTS	29.7	29.7	29.7	29.7	29.7	34.4	29.7	34.4	29.7	34.4

Table A-11

TCC NAVAL CBC GULFPORT
COST DATA

	FY80 ALTERNATIVE 1	FY80 ALTERNATIVE 2	FY81 ALTERNATIVE 1	FY81 ALTERNATIVE 2	FY82 ALTERNATIVE 1	FY82 ALTERNATIVE 2	FY83 ALTERNATIVE 1	FY83 ALTERNATIVE 2	FY84 ALTERNATIVE 1	FY84 ALTERNATIVE 2
NON-RECURRING COSTS	47.7	--	37.6	--	96.0	45.6	--	--	--	--
RECURRING COSTS										
Supplies	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4
Repair Parts										
Reproduction	.8	.8	.8	.8	.8	.8	.8	.8	.8	.8
Offline Equip.	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
AUTODIN Equip.	5.1	5.1	5.1	5.1	--	--	--	--	--	--
Other	--	--	--	--	--	--	--	--	--	--
TOTAL	8.9	8.9	8.9	8.9	3.8	3.8	3.8	3.8	3.8	3.8
Leases										
AUTODIN Circuits	2.7	3.2	2.7	3.2	2.7	3.2	2.7	3.2	2.7	3.2
LDMX/RIXT Maint.	--	--	--	--	8.5	8.5	8.5	8.5	8.5	8.5
Other	--	--	--	--	--	--	--	--	--	--
TOTAL	2.7	3.2	2.7	3.2	11.2	11.7	11.7	11.7	11.7	11.7
TOTAL RECURRING COSTS	12.0	12.5	12.0	12.5	15.4	15.9	15.4	15.9	15.4	15.9

Table A-12

NSA (EB) NEW ORLEANS LDMX TOTAL SYSTEM
COST DATA

	FY80 ALTERNATIVE 1	FY80 ALTERNATIVE 2	FY81 ALTERNATIVE 1	FY81 ALTERNATIVE 2	FY82 ALTERNATIVE 1	FY82 ALTERNATIVE 2	FY83 ALTERNATIVE 1	FY83 ALTERNATIVE 2	FY84 ALTERNATIVE 1	FY84 ALTERNATIVE 2
NON-RECURRING COSTS	47.7	--	37.6	--	96.2	1817.9	--	--	--	--
RECURRING COSTS										
Supplies	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2
Repair Parts										
Reproduction	69.3	69.3	69.3	69.3	69.3	69.3	69.3	69.3	69.3	69.3
Offline Equip.	7.4	7.4	7.4	7.4	7.4	6.0	7.4	6.0	7.4	6.0
AUTODIN Equip.	82.0	82.0	82.0	82.0	76.9	9.8	76.9	9.8	76.9	9.8
Other	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.8
TOTAL	175.5	175.5	175.5	175.5	170.4	101.9	170.4	101.9	170.4	101.9
Leases										
AUTODIN Circuits	15.9	16.4	15.9	16.4	15.9	19.0	15.9	19.0	15.9	19.0
LDMX/RIXT Maint.	--	--	--	--	8.5	170.6	8.5	170.6	8.5	170.6
Other	--	--	--	--	--	19.0	--	19.0	--	19.0
TOTAL	15.9	16.4	15.9	16.4	24.4	208.6	24.4	208.6	24.4	208.6
TOTAL RECURRING COSTS	240.6	241.1	240.6	241.1	244.0	359.7	244.0	359.7	244.0	359.7

Table A-13

APPENDIX B

Traffic Data for NTCC Breezy Point and NTCC NSA New Orleans LDMX/RIXT Systems

The traffic data for each LDMX and RIXT installation is presented in Table B-1 through B-13. Data for FY81 through FY84 were computed by applying the annual rate of change to the FY80 actual data. Daily volume entries represent actual monthly volumes averaged to a daily figure, and the entry labelled "High Day Total" represents total volume experienced on an average high-volume day. Annual volumes are simply 365 times the daily averages.

All figures presented in this appendix were drawn from References 2 and 3.

NTCC BREEZY POINT
TRAFFIC DATA

60 Subscriber Commands

Annual Rate of Change = 5.82%

	FY80	FY81	FY82	FY83	FY84	FY85
DAILY AVERAGE						
Narrative	2228	2353	2495	2640	2794	2957
Data	159	168	178	188	199	211
Total	2387	2521	2673	2828	2993	3168
HIGH DAY						
Narrative	7652	8097	8518	9014	9539	10094
Data	197	208	221	233	247	261
Total	7849	8305	8739	9247	9786	10355
ANNUAL VOLUME	871K	920K	976K	1032K	1092K	1156K

Table B-1

TCC NAS OCEANA
TRAFFIC DATA

43 Subscriber Commands

Annual Rate of Change:
Narrative = 8.5%
Data = 18.6%

	FY80	FY81	FY82	FY83	FY84	FY85
DAILY AVERAGE						
Narrative	474	514	558	605	657	713
Data	137	162	193	228	270	320
Total	611	676	751	833	927	1033
HIGH DAY						
Narrative	855	928	1006	1092	1185	1286
Data	288	342	405	480	570	676
Total	1143	1270	1411	1572	1755	1962
ANNUAL VOLUME	233K	247K	274K	304K	338K	377K

Table B-2

NTCC NSC NORFOLK
TRAFFIC DATA

15 Subscriber Commands

Annual Rate of Change:
Narrative = 7.4%
Data = 7.5%

	FY80	FY81	FY82	FY83	FY84	FY85
DAILY AVERAGE						
Narrative	871	953	1005	1079	1159	1245
Data	843	906	974	1047	1126	1210
Total	1714	1859	1979	2126	2285	2455
HIGH DAY						
Narrative	1531	1644	1245	1337	1436	1542
Data	1414	1520	1634	1757	1888	2030
Total	2945	3164	2879	3094	3324	3572
ANNUAL VOLUME	626K	679K	722K	776K	834K	896K

Table B-3

TCC YORKTOWN
TRAFFIC DATA

8 Subscriber Commands

Annual Rate of Change:
Narrative = 11.1%
Data = 2.0%

	FY80	FY81	FY82	FY83	FY84	FY85
DAILY AVERAGE						
Narrative	230	256	284	315	350	389
Data	266	271	277	282	288	294
Total	496	527	561	597	638	683
HIGH DAY						
Narrative	260	289	321	357	396	440
Data	362	369	378	384	392	400
Total	628	658	699	741	788	840
ANNUAL VOLUME	181K	192K	205K	218K	234K	249K

Table B-4

TCC USCG DISTRICT 5
TRAFFIC DATA

6 Subscriber Commands

Annual Rate of Change:
Narrative = 3.3%
Data = 0

	FY80	FY81	FY82	FY83	FY84	FY85
DAILY AVERAGE						
Narrative	484	500	516	534	551	569
Data	--	--	--	--	--	--
Total	484	500	516	534	551	569
HIGH DAY						
Narrative	262	271	280	289	299	309
Data	--	--	--	--	--	--
Total	262	271	280	289	299	309
ANNUAL VOLUME	177K	183K	188K	193K	201K	208K

Table B-5

NTCC PORTSMOUTH
TRAFFIC DATA

Annual Rate of Change:
Narrative = 5.5%
Data = 7.0%

	FY80	FY81	FY82	FY83	FY84	FY85
DAILY AVERAGE						
Narrative	803	847	895	943	995	1050
Data	153	164	175	187	201	215
Total	956	1011	1070	1130	1196	1265
HIGH DAY						
Narrative	1402	1479	1560	1646	1737	1834
Data	462	494	529	566	606	648
Total	1864	1973	2089	2212	2343	2482
ANNUAL VOLUME	349K	369K	391K	412K	437K	462K

Table B-6

NTCC BREEZY POINT LDMX TOTAL SYSTEM
TRAFFIC DATA

169 Subscriber Commands

Annual Rate of Change = 6.2%

	FY80	FY81	FY82	FY83	FY84	FY85
DAILY AVERAGE						
Narrative	5090	5423	5753	6116	6506	6923
Data	1558	1671	1797	1932	2084	2250
Total	6648	7094	7550	8048	8590	9173
HIGH DAY						
Narrative	11962	12708	12930	13735	14592	15196
Data	2723	2933	3167	3420	3703	4015
Total	14685	15641	16097	17155	18295	19211
ANNUAL VOLUME	2427K	2589K	2756K	2938K	3135K	3348K

Table B-7

NTCC NSA (EB) NEW ORLEANS
TRAFFIC DATA

34 Subscriber Commands

Annual Rate of Change:
Narrative = 9.0%
Data = 11.9%

	FY80	FY81	FY82	FY83	FY84	FY85
DAILY AVERAGE						
Narrative	1911	2083	2270	2475	2698	2941
Data	134	150	168	188	210	235
Total	2045	2233	2438	2663	2908	3176
HIGH DAY						
Narrative	3200	3488	3802	4144	4517	4924
Data	230	257	288	322	361	404
Total	3430	3745	4090	4466	4878	5328
ANNUAL VOLUME	746K	815K	890K	972K	1061K	1159K

Table B-8

NTCC NEW ORLEANS DET BELLE CHASSE
TRAFFIC DATA

13 Subscriber Commands

Annual Rate of Change:
Narrative = 1.8%
Data = 0%

	FY80	FY81	FY82	FY83	FY84	FY85
DAILY AVERAGE						
Narrative	157	160	163	166	169	172
Data	--	--	--	--	--	--
Total	157	160	163	166	169	172
HIGH DAY						
Narrative	304	309	315	321	326	385
Data	--	--	--	--	--	--
Total	304	309	315	321	326	385
ANNUAL VOLUME	57K	58K	59K	61K	62K	63K

Table B-9

TCC 159TH TFG NEW ORLEANS
TRAFFIC DATA

12 Subscriber Commands

Annual Rate of Change:
Narrative = 23.3%
Data = 24.9%

	FY80	FY81	FY82	FY83	FY84	FY85
DAILY AVERAGE						
Narrative	57	70	87	106	131	148
Data	11	14	17	21	28	35
Total	68	84	104	127	159	183
HIGH DAY						
Narrative	25	31	38	47	58	72
Data	59	74	92	115	144	180
Total	84	105	130	162	202	252
ANNUAL VOLUME	30K	38K	38K	46K	58K	67K

Table B-10

TCC LMVD VICKSBURG DISTRICT USA COE VICKSBURG
TRAFFIC DATA

7 Subscriber Commands

Annual Rate of Change:
Narrative = 10.0%
Data = 0%

	FY80	FY81	FY82	FY83	FY84	FY85
DAILY AVERAGE						
Narrative	140	154	169	186	205	226
Data	--	--	--	--	--	--
Total	140	154	169	186	205	226
HIGH DAY						
Narrative	217	239	263	289	318	350
Data	--	--	--	--	--	--
Total	217	239	263	289	318	350
ANNUAL VOLUME	51K	56K	62K	68K	75K	82K

Table B-11

TCC NAVAL CBC GULFPORT
TRAFFIC DATA

18 Subscriber Commands

Annual Rate of Change:
Narrative = 5.0%
Data = 5.0%

	FY80	FY81	FY82	FY83	FY84	FY85
DAILY AVERAGE						
Narrative	119	125	131	138	145	152
Data	33	35	36	38	40	42
Total	152	160	167	176	185	194
HIGH DAY						
Narrative	185	194	204	214	225	236
Data	203	213	224	235	247	259
Total	388	407	428	449	472	497
ANNUAL VOLUME	55K	58K	61K	64K	68K	71K

Table B-12

NSA (EB) NEW ORLEANS LDMX TOTAL SYSTEM
TRAFFIC DATA

84 Subscriber Commands

Annual Rate of Change = 8.3%

	FY80	FY81	FY82	FY83	FY84	FY85
DAILY AVERAGE						
Narrative	2384	2592	2820	3071	3348	3659
Data	178	199	221	247	278	312
Total	2562	2791	3041	3318	3626	3951
HIGH DAY						
Narrative	3931	4261	4622	5015	5444	5967
Data	492	544	604	672	752	843
Total	4423	4805	5226	5687	6196	6810
ANNUAL VOLUME	935K	1019K	1110K	1211K	1323K	1442K

Table B-13

APPENDIX C

Manpower Data for NTCC Breezy Point
and NTCC NSA New Orleans
LDMX/RIXT Systems

The manpower data for each LDMX and RIXT installation is presented in Tables C-1 through C-13. Manpower costs were computed on the basis of $26.0K for each officer, $11.0K for each enlisted member, and $18.2K for each civilian. The data sources are References 2 and 3.

NTCC BREEZY POINT
MANPOWER DATA

	ALTERNATIVE 1	ALTERNATIVE 2
MANNING LEVEL		
Officer	1	2
Enlisted	55	60
Civilian	18	18
MANNING COST		
Officer	$26.0K	$52.0K
Enlisted	$605.0K	$660.0K
Civilian	$327.6K	$327.6K
Total	$958.6K	$1039.6K

Table C-1

TCC NAS OCEANA
MANPOWER DATA

	ALTERNATIVE 1	ALTERNATIVE 2
MANNING LEVEL		
Officer	0	0
Enlisted	21	21
Civilian	0	0
MANNING COST		
Officer	--	--
Enlisted	$231.0K	$231.0K
Civilian	--	--
Total	$231.0K	$231.0K

Table C-2

NTCC NSC NORFOLK
MANPOWER DATA

	ALTERNATIVE 1	ALTERNATIVE 2
MANNING LEVEL		
Officer	0	0
Enlisted	0	0
Civilian	33	27
MANNING COST		
Officer	--	--
Enlisted	--	--
Civilian	$600.6K	$491.4K
Total	$600.6K	$491.4K

Table C-3

TCC YORKTOWN
MANPOWER DATA

	ALTERNATIVE 1	ALTERNATIVE 2
MANNING LEVEL		
Officer	0	0
Enlisted	10	10
Civilian	4	4
MANNING COST		
Officer	--	--
Enlisted	$110.0K	$110.0K
Civilian	$72.8K	$72.8K
Total	$182.8K	$182.8K

Table C-4

TCC USCG DISTRICT 5
MANPOWER DATA

	ALTERNATIVE 1	ALTERNATIVE 2
MANNING LEVEL		
Officer	0	0
Enlisted	14	14
Civilian	0	0
MANNING COST		
Officer	--	--
Enlisted	$154.0K	$154.0K
Civilian	--	--
Total	$154.0K	$154.0K

Table C-5

NTCC PORTSMOUTH
MANPOWER DATA

	ALTERNATIVE 1	ALTERNATIVE 2
MANNING LEVEL		
Officer	0	0
Enlisted	19	15
Civilian	10	10
MANNING COST		
Officer	--	--
Enlisted	$209.0K	$165.0K
Civilian	$182.0K	$182.0K
Total	$391.0K	$347.0K

Table C-6

NTCC BREEZY POINT LDMX TOTAL SYSTEM
MANPOWER DATA

	ALTERNATIVE 1	ALTERNATIVE 2
MANNING LEVEL		
Officer	1	2
Enlisted	121	122
Civilian	65	61
MANNING COST		
Officer	$26.0K	$52.0K
Enlisted	$1331.0K	$1342.0K
Civilian	$1183.0K	$1110.2K
Total	$2540.0K	$2504.2K

Table C-7

NTCC NSA (EB) NEW ORLEANS
MANPOWER DATA

	ALTERNATIVE 1	ALTERNATIVE 2
MANNING LEVEL		
Officer	1	1
Enlisted	7	7
Civilian	34	59
MANNING COST		
Officer	$26.0K	$26.0K
Enlisted	$77.0K	$77.0K
Civilian	$618.8K	$1073.8K
Total	$721.8K	$1176.8K

Table C-8

NTCC NEW ORLEANS DET BELLE CHASSE
MANPOWER DATA

	ALTERNATIVE 1	ALTERNATIVE 2
MANNING LEVEL		
Officer	0	0
Enlisted	4	4
Civilian	4	4
MANNING COST		
Officer	--	--
Enlisted	$44.0K	$44.0K
Civilian	$72.8K	$72.8K
Total	$116.8K	$116.8K

Table C-9

TCC 159TH TFG NEW ORLEANS
MANPOWER DATA

	ALTERNATIVE 1	ALTERNATIVE 2
MANNING LEVEL		
Officer	0	0
Enlisted	0	0
Civilian	2	2
MANNING COST		
Officer	--	--
Enlisted	--	--
Civilian	$36.4K	$36.4K
Total	$36.4K	$36.4K

Table C-10

TCC LMVD VICKSBURG DISTRICT USA COE VICKSBURG
MANPOWER DATA

	ALTERNATIVE 1	ALTERNATIVE 2
MANNING LEVEL		
Officer	0	0
Enlisted	0	0
Civilian	5	5
MANNING COST		
Officer	--	--
Enlisted	--	--
Civilian	$91.0K	$91.0K
Total	$91.0K	$91.0K

Table C-11

TCC NAVAL CBC GULFPORT
MANPOWER DATA

	ALTERNATIVE 1	ALTERNATIVE 2
MANNING LEVEL		
Officer	0	0
Enlisted	9	9
Civilian	0	0
MANNING COST		
Officer	--	--
Enlisted	$99.0K	$99.0K
Civilian	--	--
Total	$99.0K	$99.0K

Table C-12

NSA (EB) NEW ORLEANS LDMX TOTAL SYSTEM
MANPOWER DATA

	ALTERNATIVE 1	ALTERNATIVE 2
MANNING LEVEL		
Officer	1	1
Enlisted	20	20
Civilian	45	70
MANNING COST		
Officer	$26.0K	$26.0K
Enlisted	$220.0K	$220.0K
Civilian	$819.0K	$1274.0K
Total	$1065.0K	$1520.0K

Table C-13

APPENDIX D

List of Subscribers
to Proposed LDMX Total Systems
at NTCC Breezy Point
and NTCC NSA (EB) New Orleans

A. NTCC BREEZY POINT

AIR TERMINAL, NAVAL SUPPLY CENTER, NORFOLK, VA

ARMED FORCES COURIER STATION, NORFOLK, VA

AVIATION MATERIAL OFFICE, ATLANTIC

CHIEF OF NAVAL AIR RESERVE, ATLANTIC FLEET REPRESENTATIVE, NORFOLK, VA

COMMANDER FLEET ELECTRONIC WARFARE SUPPORT GROUP

COMMANDER, NAVAL AIR FORCES, US ATLANTIC FLEET

COMMANDER, HELICOPTER RESERVE WING REPRESENTATIVE, ATLANTIC

COMMANDER, RESERVE PATROL WING ATLANTIC

COMMANDER, TACTICAL SUPPORT WING ONE

COMMANDER, SERVICE GROUP TWO

DEFENSE MAPPING AGENCY OFFICE, NORFOLK, VA

FLEET ACCOUNTING AND DISBURSING CENTER, ATLANTIC

NAVY REGIONAL DATA AUTOMATION CENTER

FLEET TECHNICAL SUPPORT DEPARTMENT

HEADQUARTERS AND MAINTENANCE SQUADRON 46 DETACHMENT

MARINE CORPS MEDIUM HELICOPTER SQUADRON 774

MARINE CORPS AIR BASE SQUADRON

LIGHT AIRBORNE MULTI-PURPOSE SYSTEMS DETACHMENT 2

MILITARY AIR TRAFFIC COORDINATION OFFICE

LIGHT HELICOPTER ATTACK SQUADRON FOUR

HELICOPTER MINE COUNTERMEASURES SQUADRON 14

HELICOPTER MINE COUNTERMEASURES SQUADRON 16

HELICOPTER SUPPORT SQUADRON 6

FLEET AVIATION SPECIALIZED OPERATIONAL TRAINING GROUP ATLANTIC

FLEET COMPOSITE SQUADRON 6

FLEET LOGISTIC SUPPORT SQUADRON 40

FLEET LOGISTIC SUPPORT SQUADRON 56

ATLANTIC FLEET AUDIO VISUAL COMMAND

ATLANTIC FLEET NAVAL FACILITIES ENGINEERING COMMAND

ATLANTIC FLEET NAVAL AVIATION ENGINEERING SERVICE COORDINATING OFFICE

NAVAL AIR STATION, NORFOLK, VA

NAVAL COURIER SERVICE DETACHMENT VICTOR

NAVY EDUCATION AND TRAINING SUPPORT CENTER, ATLANTIC

NAVAL AIR MAINTENANCE TRAINING GROUP DETACHMENT

NAVAL AIR REWORK FACILITY

AVIATION PHYSIOLOGY TRAINING UNIT, NAS NORFOLK, VA

NAVY SAFETY CENTER

SUPPLY DEPARTMENT, NAVAL AIR STATION, NORFOLK, VA

NAVAL AIR TECHNICAL TRAINING CENTER, LAKEHURST, NJ, DETACHMENT

OPERATING LOCATION BRAVO, 21ST AIR FORCE

PERSONNEL SUPPORT DETACHMENT, NAVAL AIR STATION, NORFOLK, VA

SHORE BASED INTERMEDIATE MAINTENANCE ACTIVITY, COMNAVAIRLANT

TACTICAL ELECTRONICS WARFARE SQUADRON 33

TACTICAL ELECTRONICS WARFARE SQUADRON 209

20TH STAFF GROUP

AIRCRAFT FERRY SQUADRON 31

CARRIER AIRBORNE EARLY WARNING WING TWELVE

CARRIER AIRBORNE EARLY WARNING SQUADRON 78

CARRIER AIRBORNE EARLY WARNING SQUADRON 121

CARRIER AIRBORNE EARLY WARNING SQUADRON 122

CARRIER AIRBORNE EARLY WARNING SQUADRON 123

CARRIER AIRBORNE EARLY WARNING SQUADRON 124

CARRIER AIRBORNE EARLY WARNING SQUADRON 125

CARRIER AIRBORNE EARLY WARNING SQUADRON 126

CARRIER AIRBORNE EARLY WARNING TRAINING SQUADRON 120

USS AMERICA DETACHMENT NORFOLK, VA

COMMANDER, FLEET AIR DETACHMENT, NORFOLK, VA

NAVAL AIR RESERVE UNIT, NORFOLK, VA

FLEET ELECTRONIC WARFARE SUPPORT GROUP DETACHMENT, NORFOLK, VA

MARINE AIR GROUP DETACHMENT 46, NORFOLK, VA

B. TCC NAS OCEANA

COMTACWINGSLANT

NAVAL AIR STATION, OCEANA

COMMANDER, MEDIUM ATTACK WING ONE

COMMANDER, FIGHTER WING ONE

MEDIUM ATTACK WING ONE

FIGHTER WING ONE

NAVAL ELECTRONICS SUPPORT UNIT, NAS OCEANA

FIGHTER SQUADRON ONE HUNDRED ONE

FLEET AIR INTELLIGENCE SUPPORT CENTER

FLEET COMPOSITE SQUADRON TWO

NAVAL AIR MAINTENANCE TRAINING DETACHMENTS

ATTACK SQUADRON FORTY-TWO

NAVAL GUIDED MISSILES SCHOOL, DAM NECK

FLEET COMPOSITE SQUADRON TWELVE

FLEET AVIATION SPECIALIZED OPERATIONAL TRAINING GROUP DET

NAVAL OCEANOGRAPHIC OFFICE DETACHMENT OCEANA, VA

FLEET COMPOSITE SQUADRON SIX, DAM NECK, VA

FIGHTER SQUADRON ONE ZERO ONE

FLEET AREA CONTROL AND SURVEILLANCE FACILITY VACAPES, OCEANA, VA

FLEET COMBAT DIRECTION SYSTEMS SUPPORT ACTIVITY, DAM NECK, VA

FLEET COMBAT SYSTEMS TRAINING CENTER ATLANTIC, DAM NECK, VA

PERSONNEL SUPPORT DETACHMENT, OCEANA, VA

PERSONNEL SUPPORT DETACHMENT

TACTICAL ELECTRONIC WARFARE SQUADRON DETACHMENT THREE THREE

COMMANDER, CARRIER AIR WING SIX

COMMANDER, CARRIER AIR WING SEVEN

COMMANDER, CARRIER AIR WING EIGHT

COMMANDER, CARRIER AIR WING ONE

COMMANDER, CARRIER AIR WING ONE SEVEN

NAVAL AIR MAINTENANCE TRAINING TYPE COMMANDER LIAISON OFFICER

NAVAL EDUCATION AND TRAINING SUPPORT CENTER FIELD OFFICE, OCEANA, VA

NAVAL EDUCATION AND TRAINING SUPPORT CENTER FIELD OFFICE, DAM NECK, VA

NAVAL AIR SYSTEMS COMMAND ATLANTIC FIELD SERVICE REP, OCEANA, VA

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OLAA 20 ADS, OCEANA, VA

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AVIATION CLASSIFICATION REPAIR ACTIVITY DEPOT

255TH COMBAT COMMUNICATIONS SQUADRON (CONTG)

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